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be attributed to the enhanced dissociation and dissolution of  $\text{Mg}(\text{BH}_4)_2$ . With  $\text{LiBH}_4$ , the saturated concentration of  $\text{Mg}(\text{BH}_4)_2$  increases from 0.01M to 0.1M.

Triglyme and tetraglyme solvents in which  $\text{Mg}(\text{BH}_4)_2$  and  $\text{LiBH}_4$  were dissolved as first and second salts, respectively, can also yield effectively 100% Mg CE (i.e., no observable capacity fade within 100 cycles). However, these triglyme and tetraglyme-based embodiments also exhibited much less current density, probably due to the high viscosity which leads to low conductivity of the electrolytes.

One embodiment comprises an electrolyte saturated with  $\text{Mg}(\text{BH}_4)_2$  and 1.5M  $\text{LiBH}_4$  in diglyme and is referred to hereinafter as  $\text{MgLi1.5M}(\text{BH})\text{-2G}$ . The  $\text{MgLi1.5M}(\text{BH})\text{-2G}$  shows an electrochemical window of 1.6V on Pt electrode. On glass carbon and stainless steel electrodes, wider electrochemical windows are observable for which anodic stability is pushed to over 2.1V. This is good for using low cost materials.

FIG. 2 shows the cycling performance in  $\text{MgLi1.5M}(\text{BH})\text{-2G}$ . The Mg plating/stripping curves shift slightly during cycling (FIG. 2a). The Mg coulombic efficiency stays at 100% and the electric charge for Mg plating/stripping, which corresponds to the electrode capacity at such a cycling condition, increases slightly during cycling.

While a number of embodiments of the present invention have been shown and described, it will be apparent to those skilled in the art that many changes and modifications may be made without departing from the invention in its broader aspects. The appended claims, therefore, are intended to cover all such changes and modifications as they fall within the true spirit and scope of the invention.

We claim:

1. An energy storage device comprising an anode comprising Mg and an electrolyte solution, the electrolyte solution comprising:

an organic solvent selected from the group consisting of diglyme, triglyme, tetraglyme, and combinations thereof;

a first salt substantially dissolved in the organic solvent and comprising a magnesium cation; and

a second salt substantially dissolved in the organic solvent and comprising a magnesium cation or a lithium cation; wherein one of the first salt or the second salt comprises a  $\text{BH}_4$  anion and the other of the first salt or the second salt comprises a bis(trifluoromethanesulfonyl)imide (TFSI) anion.

2. The energy storage device of claim 1, wherein the first salt comprises  $\text{Mg}(\text{BH}_4)_2$ .

3. The energy storage device of claim 1, wherein the first salt comprises  $\text{Mg}(\text{TFSI})_2$ .

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4. The energy storage device of claim 1, wherein the anode has a capacity fade less than 80% within 50 cycles.

5. The energy storage device of claim 1, wherein the anode has a capacity fade less than 10% within 50 cycles.

6. The energy storage device of claim 1, wherein the anode has a capacity fade less than 10% within 100 cycles.

7. The energy storage device of claim 1, wherein the anode has no observable capacity fade within 100 cycles.

8. The energy storage device of claim 1, wherein the device is a rechargeable energy storage device reversibly plating and stripping Mg.

9. The energy storage device of claim 1, wherein the second salt is a solubility enhancer for the first salt.

10. A rechargeable energy storage device reversibly plating and stripping Mg, the device comprising:

an anode comprising magnesium; and

an electrolyte solution comprising an organic solvent selected from the group consisting of diglyme, triglyme, tetraglyme, and combinations thereof;

the electrolyte solution further comprising a first substantially dissolved salt comprising  $\text{Mg}(\text{BH}_4)_2$  and a second substantially dissolved salt selected from the group consisting of,  $\text{LiTFSI}$ ,  $\text{Mg}(\text{TFSI})_2$ , and combinations thereof;

the energy storage device having less than 10% anode capacity fade within 100 cycles.

11. An electrolyte solution for energy storage devices having an anode comprising magnesium, the electrolyte solution comprises:

an organic solvent comprising diglyme, triglyme, tetraglyme, or combinations thereof;

a first salt substantially soluble in the organic solvent comprising a magnesium cation; and

a second salt substantially soluble in the organic solvent and comprising a magnesium cation or a lithium cation;

wherein one of the first salt or the second salt comprises a  $\text{BH}_4$  anion and the other of the first salt or the second salt comprises a bis(trifluoromethanesulfonyl)imide (TFSI) anion.

12. The electrolyte solution of claim 11, wherein the first salt comprises  $\text{Mg}(\text{BH}_4)_2$ .

13. The electrolyte solution of claim 11, wherein the first salt comprises  $\text{Mg}(\text{TFSI})_2$ .

14. The electrolyte solution of claim 11, wherein the anode has a capacity fade less than 10% over 100 cycles.

15. The electrolyte solution of claim 11, wherein the anode has no observable capacity fade within 100 cycles.

16. The electrolyte solution of claim 11, wherein the second salt is a solubility enhancer for the first salt.

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